Space Weather Technical Forecast

Issued on Saturday, 19 March 2022 at 12:41 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1/Minor geomagnetic storms on Day 2 (20 March). Slight chance of Active fluence by Day 3 (21 March).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar Activity has been Low over the past 24 hours, with one minor C-class flare originating from AR2965 in the northwest quadrant. There are currently two numbered sunspot regions on the visible, the aforementioned AR2965, which remains the largest, although the magnetic complexity continues to reduce and it has shown some fading of the trailing spot. AR2967 also in the northwest quadrant has also faded a little more. There are two new and un-numbered sunspots emerging in the southern hemisphere, which are both small and simple Axx/Alpha groups.

No Earth-directed CMEs were observed on available imagery.

Solar Wind / Geomagnetic Activity: Solar winds, as observed by DSCOVR at L1, remained at background levels ending the period near 300 km/s. Density was at average levels throughout. The IMF, Bt, was weak at 5nT or below. The north-south component, Bz, was weak and ranged between +3/-4 nT. Phi angle was mostly negative (towards the Sun). Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) measured at GOES 16 was at background. The high energy electron flux (greater than 2 MeV) has been at generally moderate levels, peaking at 287 pfu at 18/1950 UTC. The 24-hour integrated electron fluence was well below the Active (1e8 integrated pfu) threshold, but with a rising trend. Observed fluence at 18/2359 UTC was 7.02e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be at mostly Low or Very Low levels with an ongoing slight chance of an isolated M-class flare, mainly from AR2965 in the northwest. This chance reduces on Day 3 (21 March) as AR2965 rotates off the west limb.

Solar Wind / Geomagnetic Activity: Solar winds are currently at background levels, and expected to stay that way until Day 2 (20 March). The CME from a filament eruption on March 16th may give a glancing blow early on Day 2 (20 March). Also, a possible coronal hole high speed stream may arrive during Day 2 (20 March).

Geomagnetic activity is expected to be mostly Quiet (Kp 0-2) to start. The CME arrival and/or HSS arrival will give an increased likelihood of Unsettled to Active (Kp 3-4) intervals, and a chance of G1/Minor (Kp 5) geomagnetic storms, mainly on Day 2 (20 March).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain predominantly at background levels. The high energy (greater than 2 MeV) electron flux is currently at predominantly moderate levels. Further enhancement in the near

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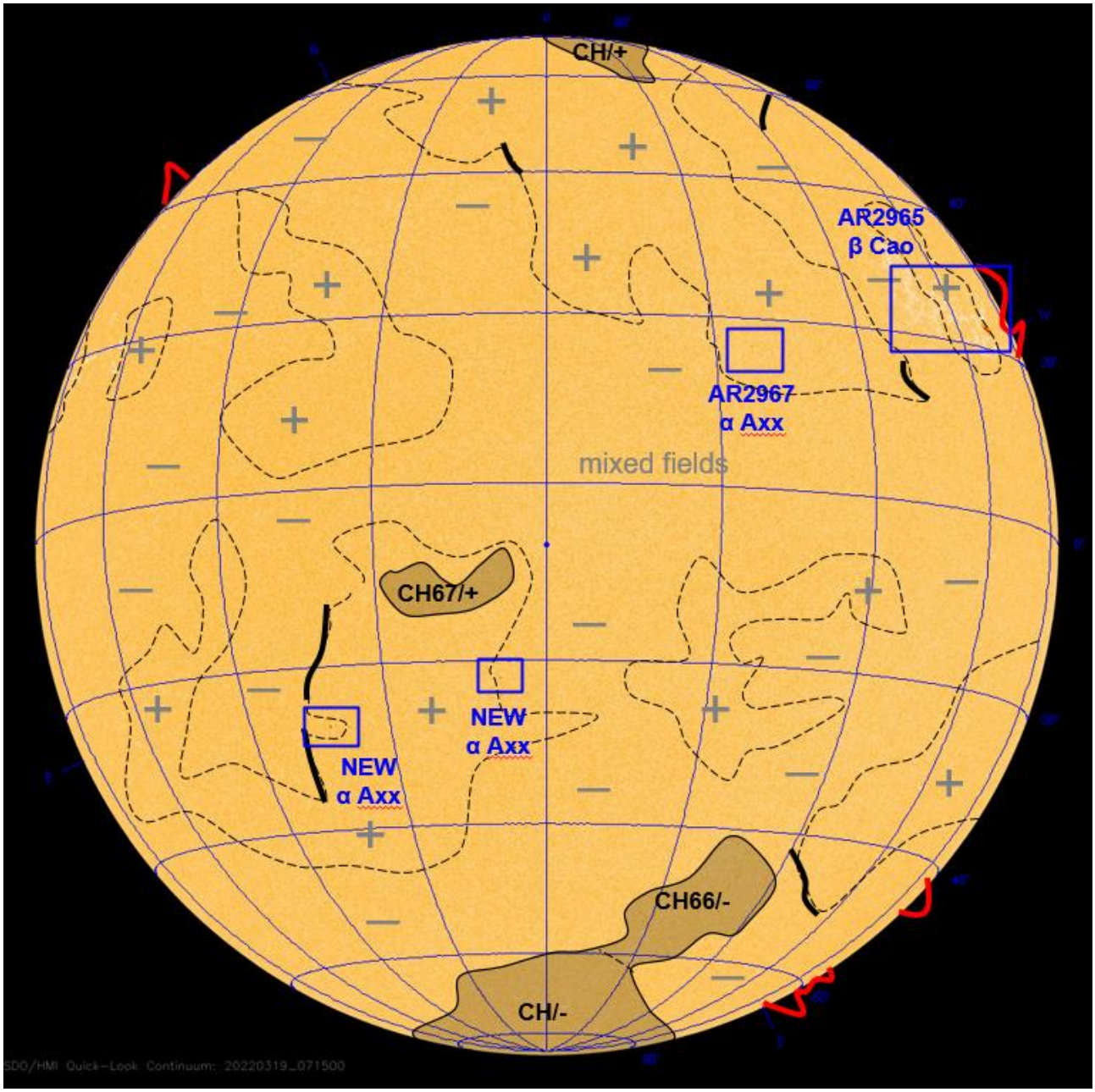
term is unlikely. A combination of a possible CME and HSS arrival on Day 2 (20 March) is likely to keep flux levels suppressed at that time. A rise is then possible on Day 3 (21 March), with a rise also possible in the associated fluence level at this time, although this is low confidence due to uncertainty in the CME/HSS forecast.

Figure 1. Solar Analysis Valid 19/0715UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Solar winds are currently at background levels, near 300km/s, and expected to stay that way until Day 2 (20 March).

The CME from a filament eruption which occurred in the northeast around 16/1230 UTC may give a glancing blow early on Day 2 (20th March). Also, a possible coronal hole high speed stream may arrive during Day 2 from CH66/-, a northern extension of the southern polar crown coronal hole. However, confidence is low regarding this feature as there are differences from the previous rotation. No wind speed increase has yet been detected at STEREO-A.

Geomagnetic activity is expected to be mostly Quiet (Kp 0-2) to start. The CME arrival and/or HSS arrival will give an increased likelihood of Unsettled to Active (Kp 3-4) intervals, and a chance of G1/Minor (Kp 5) geomagnetic storms, mainly on Day 2 (20 March).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	30	10	5
Strong	G3	No	1	2	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
16/1902UTC	Partial	Fliament eruption	NE quadrant	580km/s	20/0600UTC	Glancing Blow

Figure 2: MOSWOC Enlil (top) and ensemble (below) shows the glancing blow of a CME around 20/0600UTC.

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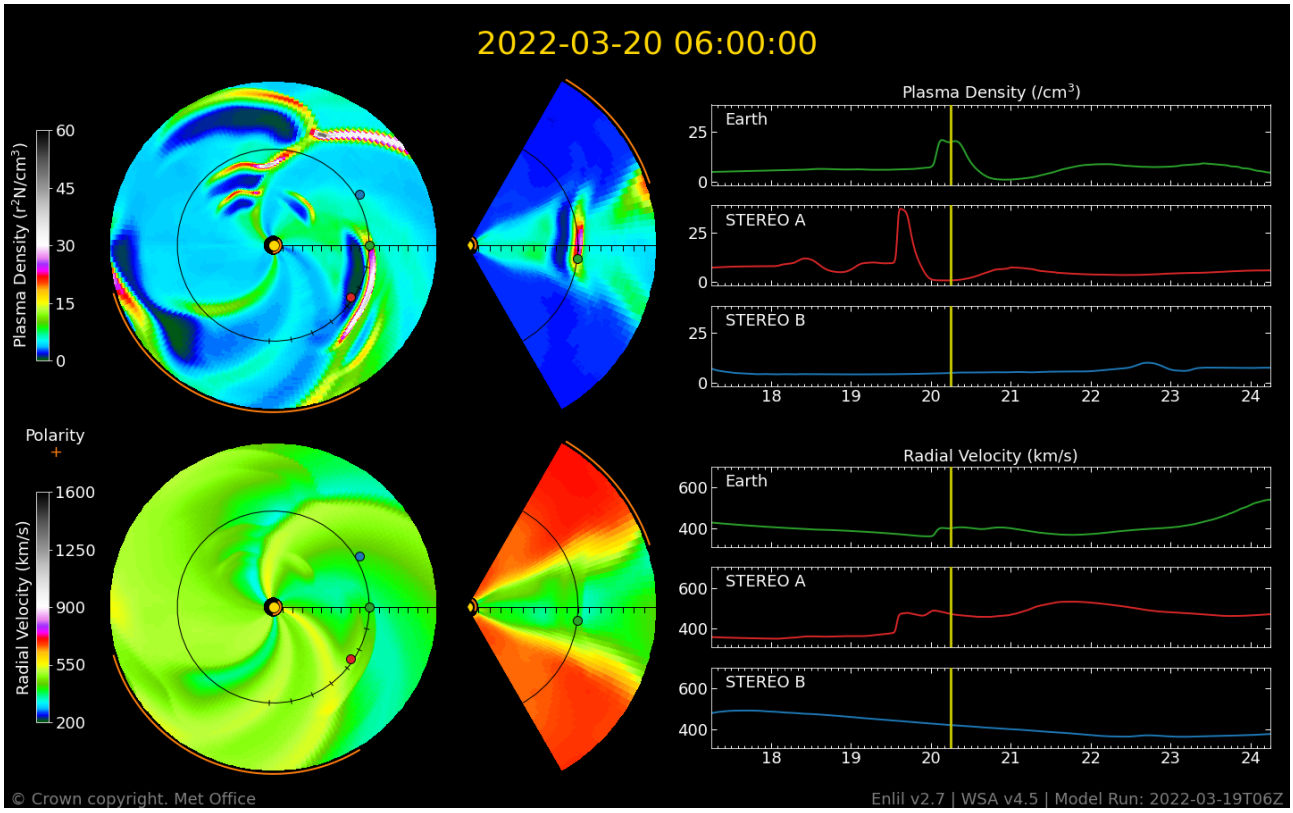

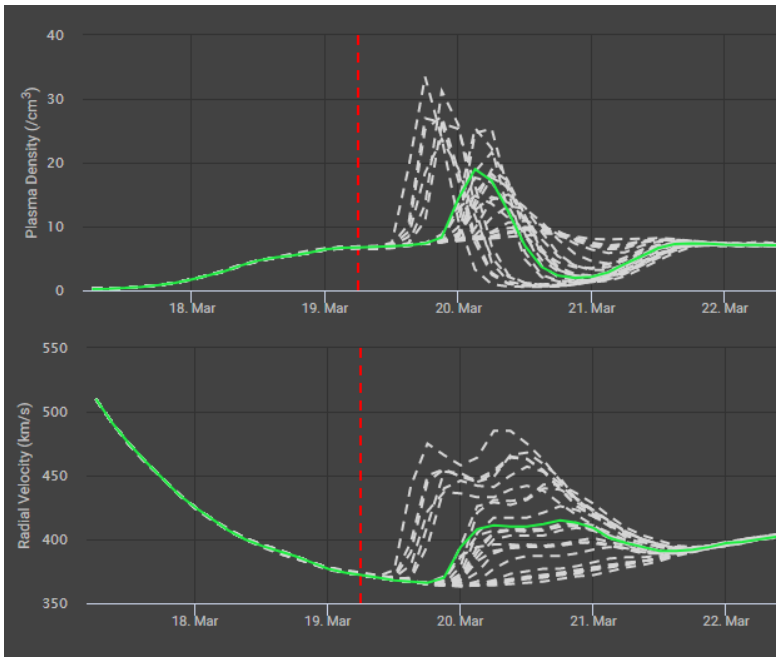

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Radio Blackouts - X-Ray Flares:

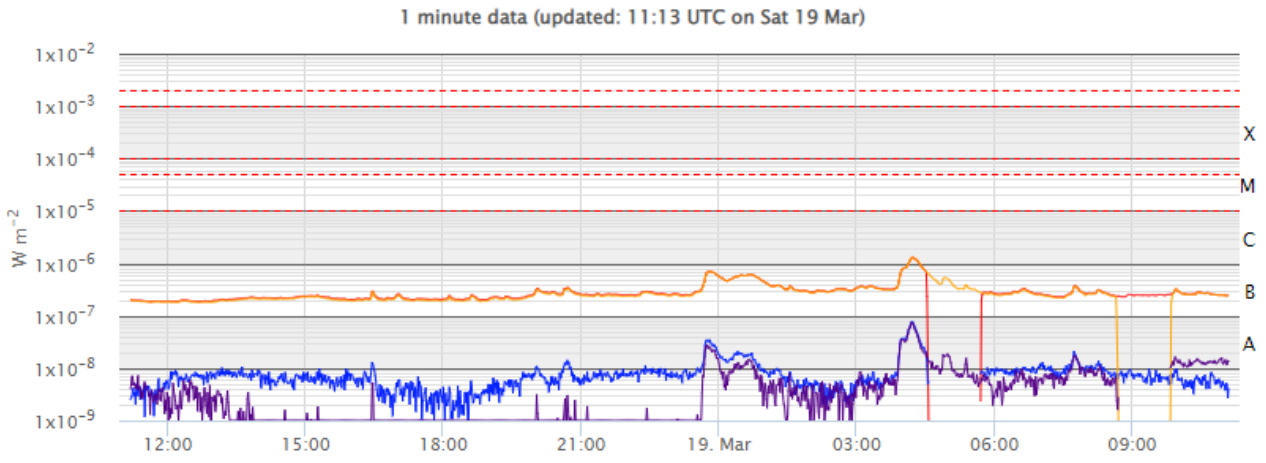
Solar Activity has been Low in the past 24 hours, with only one minor C-class flare (C1.2) originating from AR2965 in the northwest. AR2965 (Cao/Beta) in the northwest quadrant remains the largest region. It has however shown decay in its trailing spot with the penumbra fading, and a simplification of its magnetic structure. AR2967 in the northeast quadrant has also faded and is now classified Axx/Alpha. There are two new and currently un-numbered sunspots, which have recently emerged in the southern hemisphere, which are small and simple Axx/Alpha groups.

STEREO-A imagery shows possible returning regions which may rotate onto the east limb over the next few days.

Solar activity is forecast to continue mostly Very Low or Low with a slight chance of isolated M-class flares, with AR2965 the likely source. However, AR2965 is expected to rotate off the west limb during Day 3 (21 March) so the probability of M-flares will start to reduce at that point.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 M Class**	No	10	5	1	1
Very Active	**R3 to R5 X Class**	No	1	1	1	1

Figure 3: GOES-16 X-Ray Flares.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (10MeV) measured at GOES-16 is currently at background levels, and is expected to remain at this level. Any significant flares from AR2965 may give a potential enhancement, however this region has undergone some magnetic simplification and faded a little in the last 24 hours. Therefore there is now only a very slight chance of reaching the S1 level.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	2	2	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux as observed at GEO by GOES-16 is currently at predominantly moderate levels. Further enhancement in the near term is unlikely, with no recent significant wind speed enhancements which would have caused charging. A combination of a possible CME and HSS arrival on Day 2 (20 March) is likely to keep flux levels suppressed at that time. A rise is then possible on Day 3 or 4 (21 or 22 March) if the wind speed does increase, once any geomagnetic effects wane.

The associated fluence is expected to stay well below the Active (1e8 integrated pfu) threshold for much of the period. A rise is possible on Day 3 or 4, although this is low confidence due to uncertainty in the CME/HSS forecast. REFM is currently underestimating the fluence level - it is probably providing reasonable guidance until Day 3 however.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	10	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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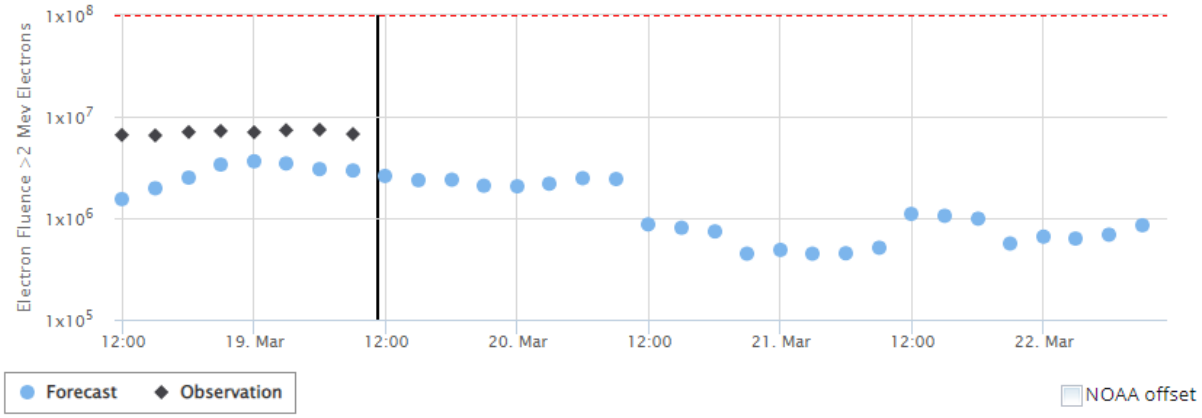
Figure 4: Met Office REFM observations and forecast – below the Active threshold.



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